Innovative, Non-Lethal Technology to Deter Marine Mammal Predation: *Proposal to Assess Effects on*

SMITH-ROOT, INC.
Technology For Fisheries Conservation

BONNEVILLE
POWER ADMINISTRATION

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Project Evolution: Must Address Specific “Go/No Go” Decision Points:

- Can sonar differentiate pinnipeds?

  Yes, no misclassifications in 160 test trials.

- Can sea lions be deterred, even with food present? Yes, extreme sensitivities. Full deterrence at 0.6 V/cm and 0.4 ms pulse width at 2 Hz. (Tests by Dr. Jeppe Terhune, Moss Landing Marine Labs.)

- Will fish pass the array (especially steelhead, lamprey, and sturgeon)

"Go/No Go" Results on Fish

(1) Steelhead Studies (Matt Mesa)

- Array did not affect fish passage at sea lion deterrence level.
- Passage reduced by 13 to 33% at incrementally higher voltage gradients during constant array operation.

(2) Pacific lamprey Research (Matt Mesa)

- Array did not affect lamprey passage at sea lion deterrence level.
- No effect on lamprey passage at double the sea lion level.

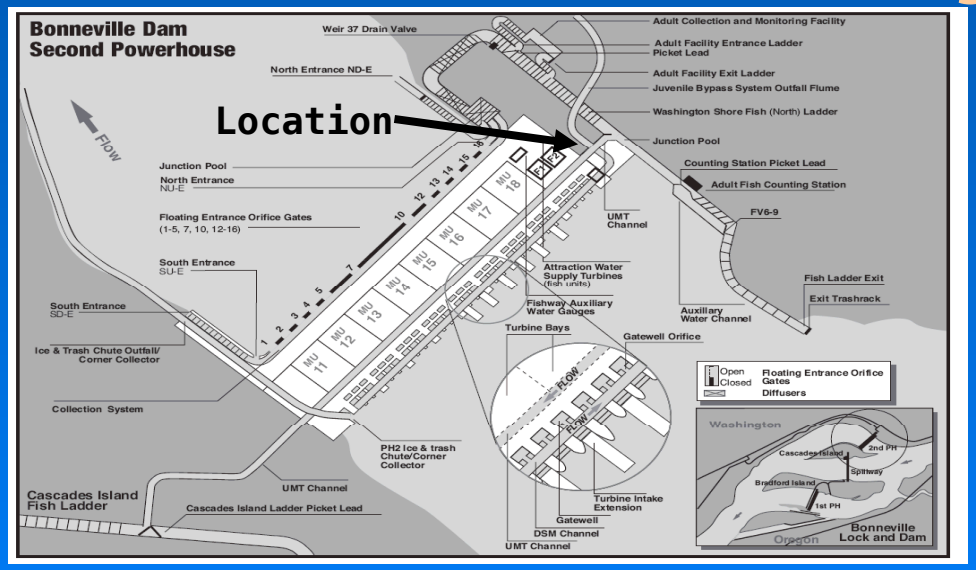
(3) White Sturgeon Tests (Ken Ostrand)

- Lamprey passage greatly reduced at 3x sea lion deterrence level.
- All sturgeon tested at 3x the sea lion deterrence level.
- Intermittent operation: sturgeon avoided array when "soft-start" technology ramped-up in power (the desired outcome).
- Recovery was rapid with no mortality (no adverse

Next Steps - This Proposal:

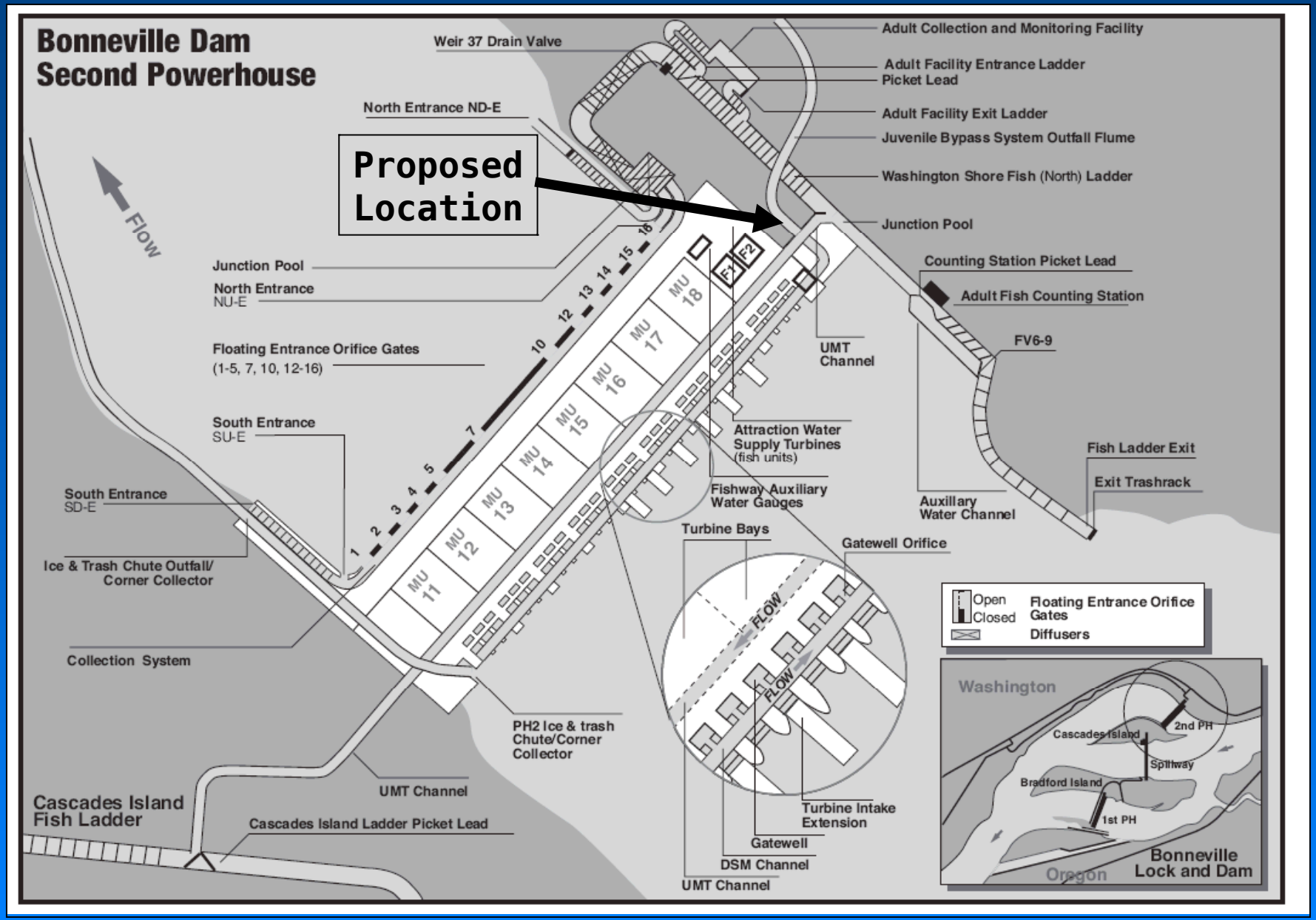
Test Array in Upstream Migrant Transport Channel (UMT) at Bonneville Dam

Goal: Evaluate fish passage responses to sea lion deterrence array in situ, during active upstream fish migrations under realistic water flow regimes.



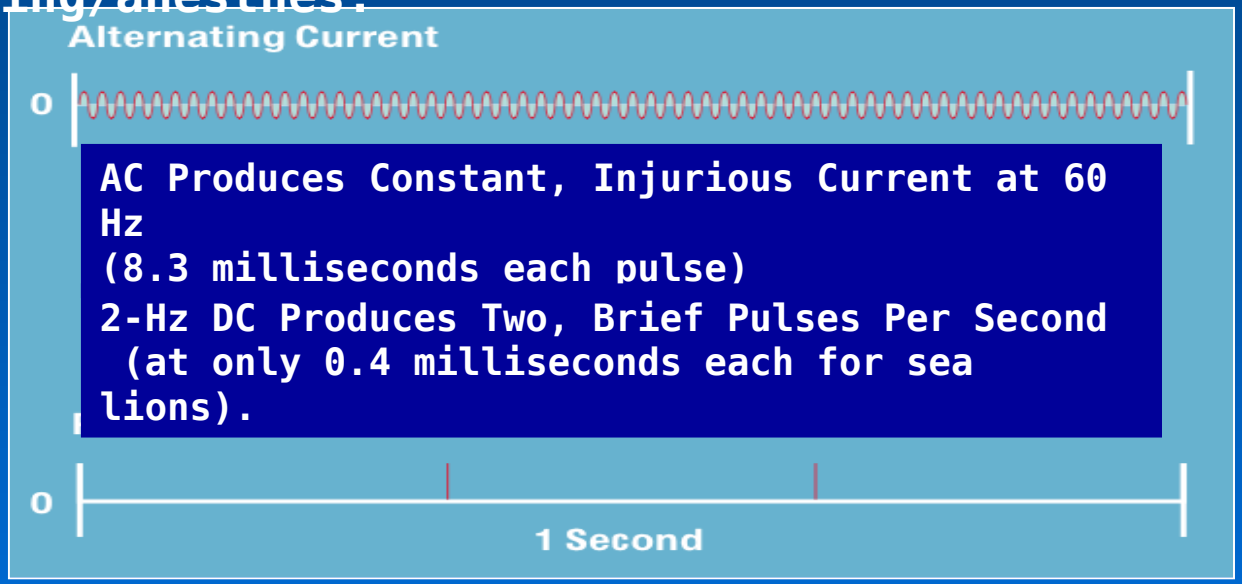
QuickTime™ and a
decompressor
are needed to see this picture.

Proposed Study Site in UMT



Sea Lion Concept Uses Very Low Power Levels:

- Field strength graduated (intensifies with proximity).
- Pulse frequency only 2 Hz: far less than field used in e-fishing/anesthes.


Alternating Current
0
AC Produces Constant, Injurious Current at 60 Hz
(8.3 milliseconds each pulse)
2-Hz DC Produces Two, Brief Pulses Per Second
(at only 0.4 milliseconds each for sea lions).
0
1 Second

Electrofishing Guidelines (NMFS - Portland, OR)

Criterion	Initial Settings	Maximum Settings
Voltage	100 Volts	Conductivity / Max Voltage <100 µS/cm: 1100 100-300 µS/cm: 800 >300 µS/cm: 400
Pulse Width	500 µs (0.0005 sec)	5 ms (0.005 sec)

Study Objectives and Approach

(1) Assess effects of “soft-starting” sea lion array (gradual power ramp-up) on actively migrating fish in UMT (Mar/Apr & June/July).

- Activate while fish present over array.
- Gradual power-up (to sea lion deterrence level).
- Monitor behavior with DIDSON cameras.
- Describe behavioral resul

(<u>Questions Addressed</u>: How do active migrants respond? Does “soft-start” clear migrating fish from areas on or near the array?)

Study Objectives and Approach

(2) Assess <u>intermittent</u> operation of array on actively migrating fish in UMT (simulates concept of array operation only when cued by arrival of a marine mammal).

- Activate during randomly chosen time blocks spanning the spawning migration window.
- Monitor fish passage with DIDSON cameras.
- Use “block-pair” study design with identical test and control time intervals.
- Statistically compare passage rates between array “on” and “off” time intervals

Study Objectives and Approach

(3) Assess effects of <u>constant</u> array operation on actively migrating fish in UMT.

- Test array operation during specific migration periods (Mar/Apr & June/July) at sea lion deterrence and higher field intensities.

- Monitor behavior with DIDSON cameras.

- Determine power levels that begin to affect fish passage behavior (what is the available operational “cushion?”).

- Describe behavioral results.

<u>Question Addressed:</u> Can sea lion deterrence settings be increased slightly, beyond 0.6 V/cm?

Expected Results and Outcomes

<u>Overall</u>: Data on how sea lion array affects behavior of actively migrating fish in-situ at Bonneville during realistic flow conditions.

) Ability to address whether “soft-start” technolog
otects fish on or near array by inducing behavioral
ange when power “ramps-up.”

(2) Ability to determine whether statistically significant differences occur in fish migration rates (numbers of migrants) between randomly selected “on” and “off” intervals (H_0: Strong Difference)

) Ability to assess whether constant operation affe
sh migration and to determine if sea lion deterrenc
vel can be elevated without affecting fish passage.

UMT Study Logistics:

Three-day installation period (Dec or Jan):

- 1-day with boom truck or crane.

Prior to Study:

- Visit site for study planning purposes.
- Test, verify and measure electric field.
- Assess effects of shielded array on PIT

Wrap-Up

Results of this study will help BPA and its natural resource partners to:

(1) Assess potential for deterrence technology to reduce predation on ESU and other fishes in the Basin.

(2) Expand previous research (focal species: salmonids, lamprey and sturgeon) conducted in hatchery settings by providing new insights on how the technology works during realistic flows in-situ, on active